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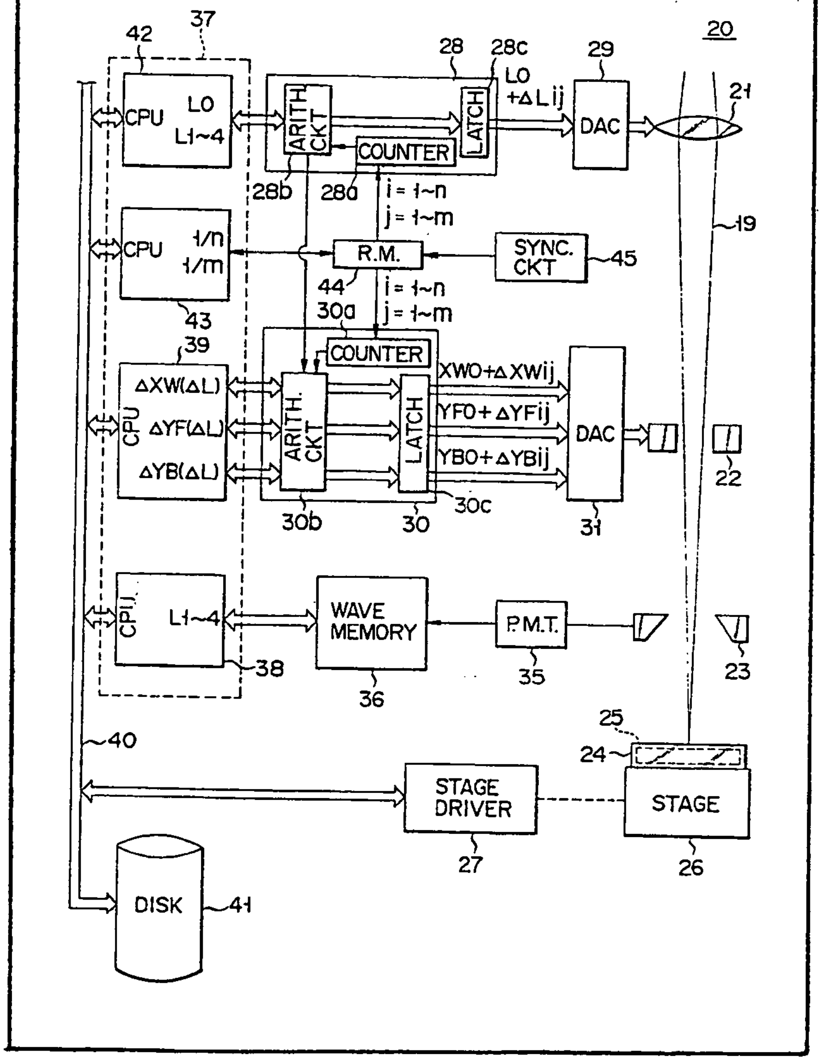
**WC2A 3LS**

## (54) Method of and apparatus for drawing an electron beam pattern

(57) Markers formed on the surface of a substrate (25) to be drawn is scanned by an electron beam (19); reflection electron intensity curves representing the states of the focus of the electron beam are obtained; objective lens output correction values corresponding to the misposition in the vertical direction of the substrate are obtained on the basis of these curves; correction values of the deflecting electrode outputs are obtained from these correction values for correction of the beam position in the horizontal direction; these correction values are added to the objective lens output and to the deflecting electrode output, thereby drawing an electron beam pattern.

F I G. 2


42
37
CPU
LO
L1~4
28
28c
ARITH CKT
LATCH
LO +ΔLij
COUNTER
29
DAC
20
21
28b
28a
i=1~n
j=1~m
19
CPU
1/n
1/m
R.M.
SYNC. CKT
45
43
44
30a
i=1~n
j=1~m
39
COUNTER
ΔXW(ΔL)
CPU
ΔYF(ΔL)
ΔYB(ΔL)
ARITH. CKT
LATCH
XW0+ΔXWij
YF0+ΔYFij
YB0+ΔYBij
DAC
22
30c
30b
30
31
CPU
L1~4
WAVE MEMORY
P.M.T.
23
38
36
35
25
40
24
STAGE DRIVER
STAGE
27
26
DISK
41

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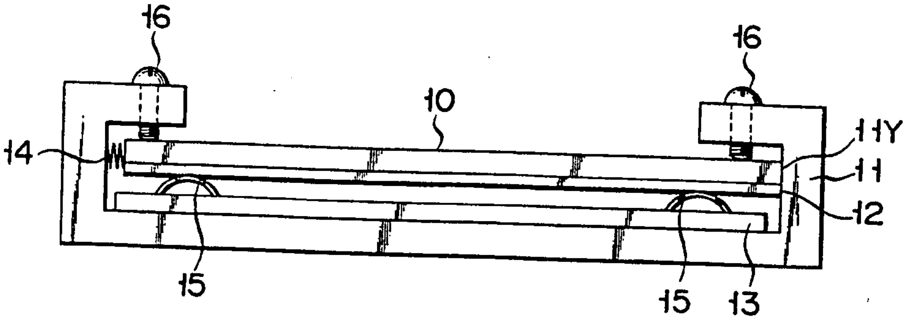
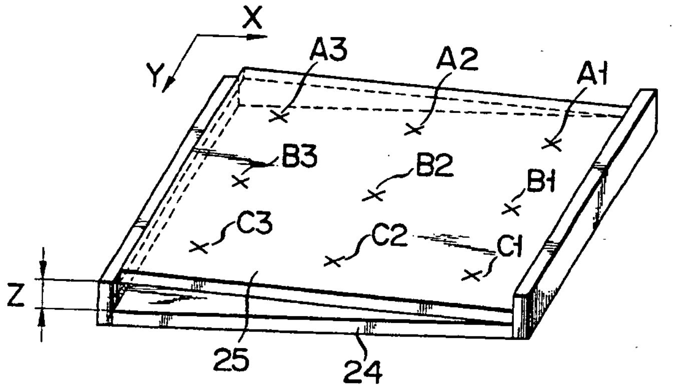
2132390

F I G. 1


16
16
10
11Y
14
11
12
15
15
13

F I G. 3


X
Y
A3
A2
A1
B3
B2
B1
C3
C2
C1
Z
25
24

F I G. 2

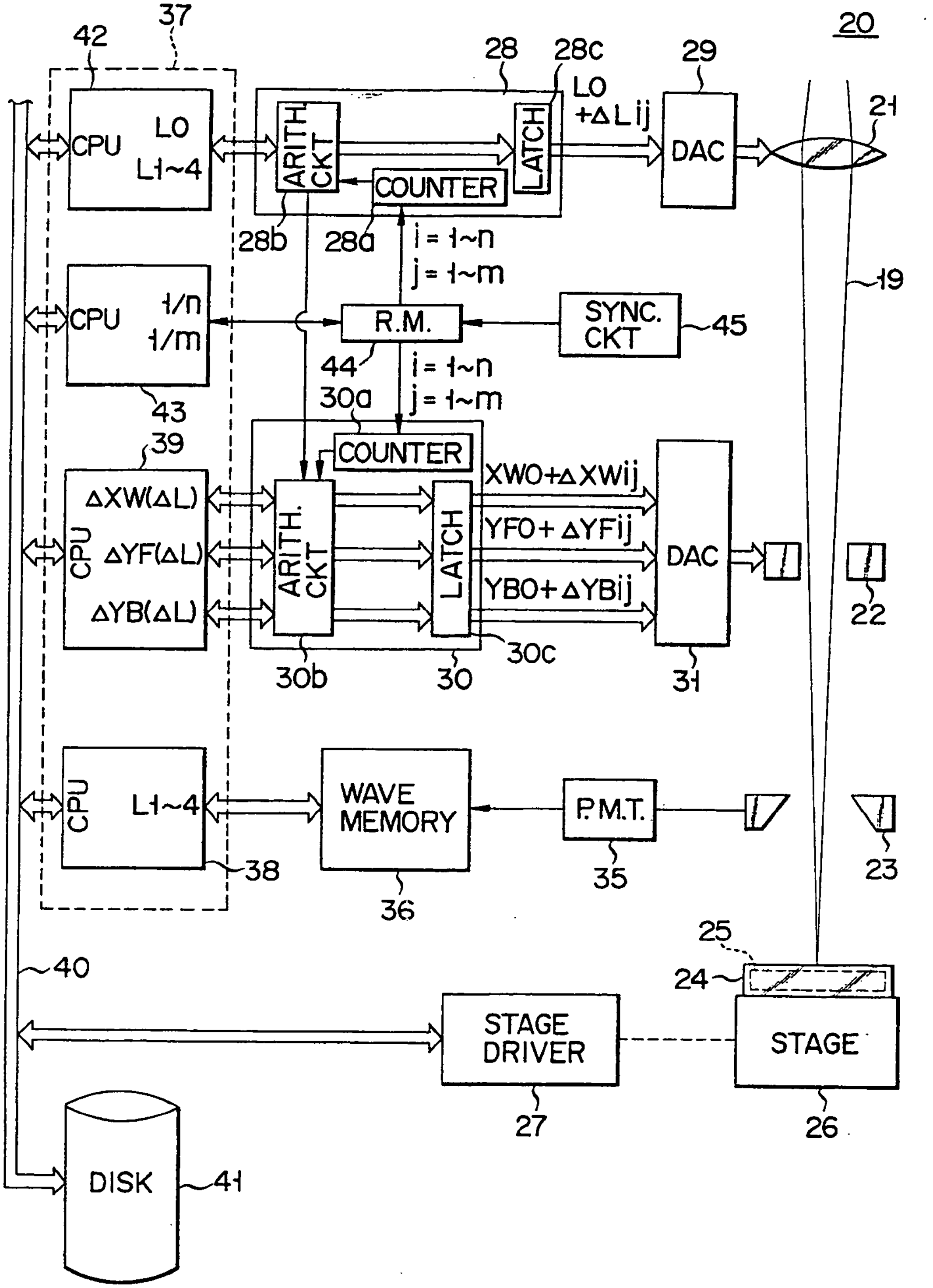

37
42
CPU
L0
L1~4
28
28c
L0
+ΔLij
29
20
21
ARITH. CKT
COUNTER
LATCH
DAC
28b
28a
i = 1~n
j = 1~m
19
CPU
1/n
1/m
R.M.
SYNC. CKT
45
44
43
30a
i = 1~n
j = 1~m
39
COUNTER
ΔXW(ΔL)
CPU
ΔYF(ΔL)
ΔYB(ΔL)
ARITH. CKT
LATCH
XW0+ΔXWij
YF0+ΔYFij
YB0+ΔYBij
DAC
22
30b
30
30c
31
CPU
L1~4
WAVE MEMORY
P.M.T.
38
36
35
23
25
24
40
STAGE DRIVER
STAGE
27
26
DISK
41

FIG. 4

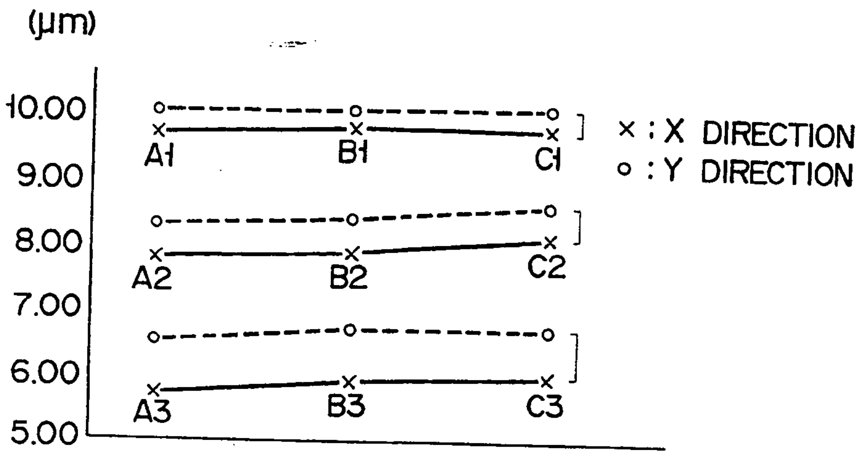
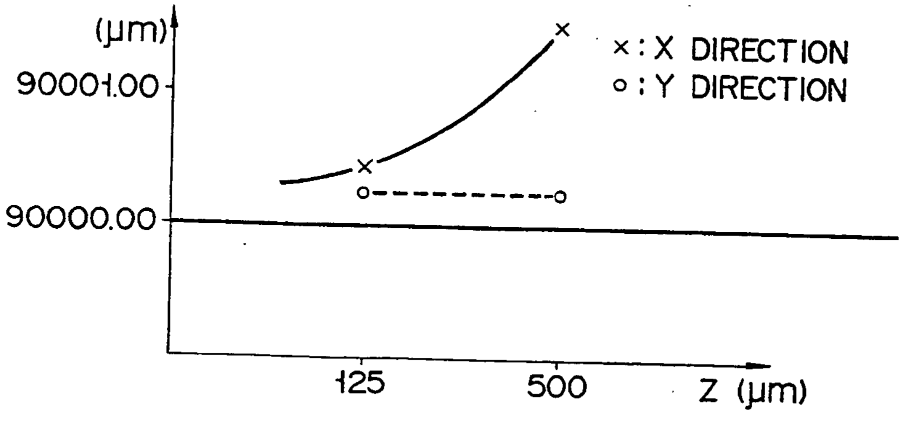

(μm)
10.00
9.00
8.00
7.00
6.00
5.00
A1
B1
C1
A2
B2
C2
A3
B3
C3
× : X DIRECTION
○ : Y DIRECTION

FIG. 5


(μm)
90001.00
90000.00
125
500
Z (μm)
× : X DIRECTION
○ : Y DIRECTION

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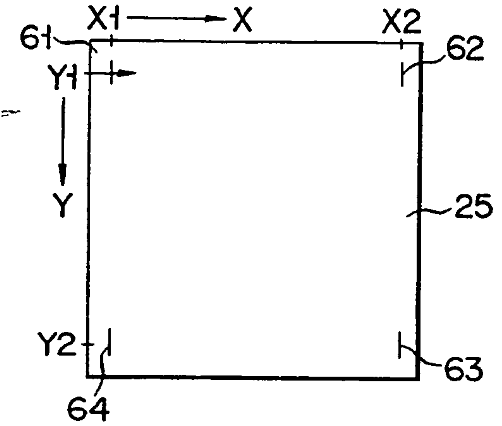
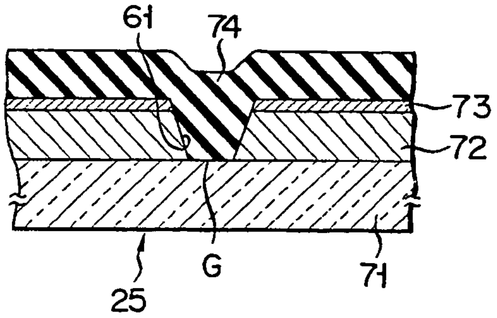
2132390

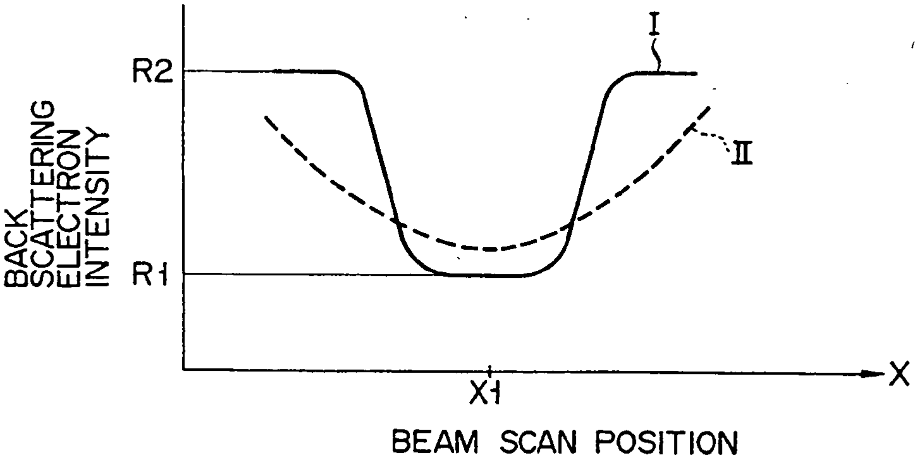
F I G. 6


X1
X
X2
61
62
Y1
Y
25
Y2
63
64

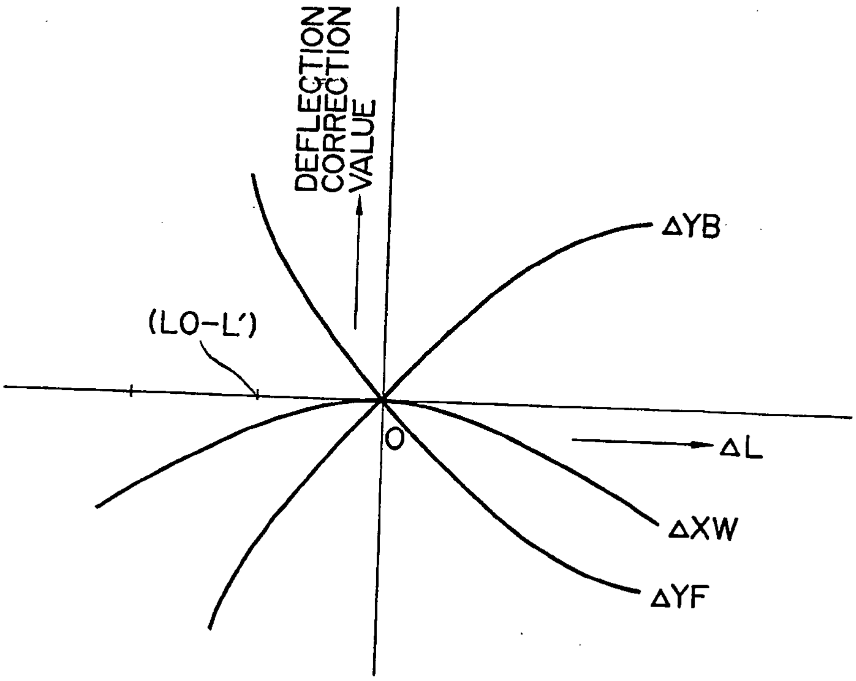
F I G. 7


61
74
73
72
25
G
71

F I G. 8



F I G. 9


DEFLECTION CORRECTION VALUE
ΔYB
(LO-L')
O
ΔL
ΔXW
ΔYF

F I G. 10

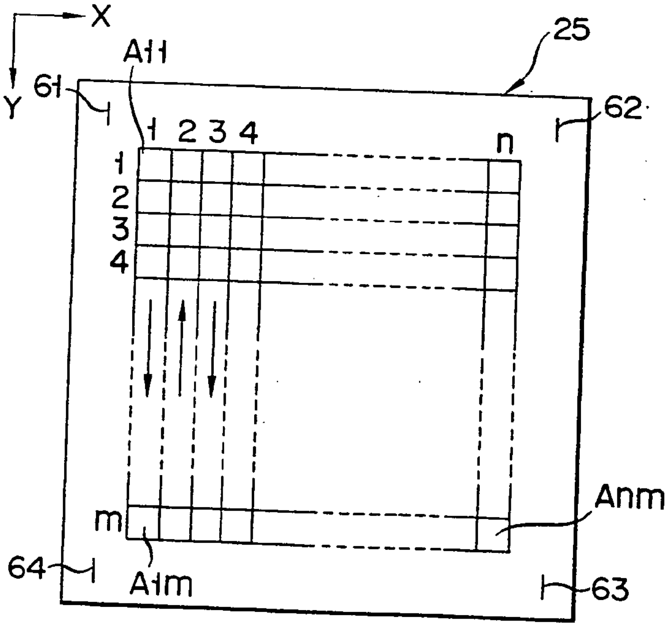
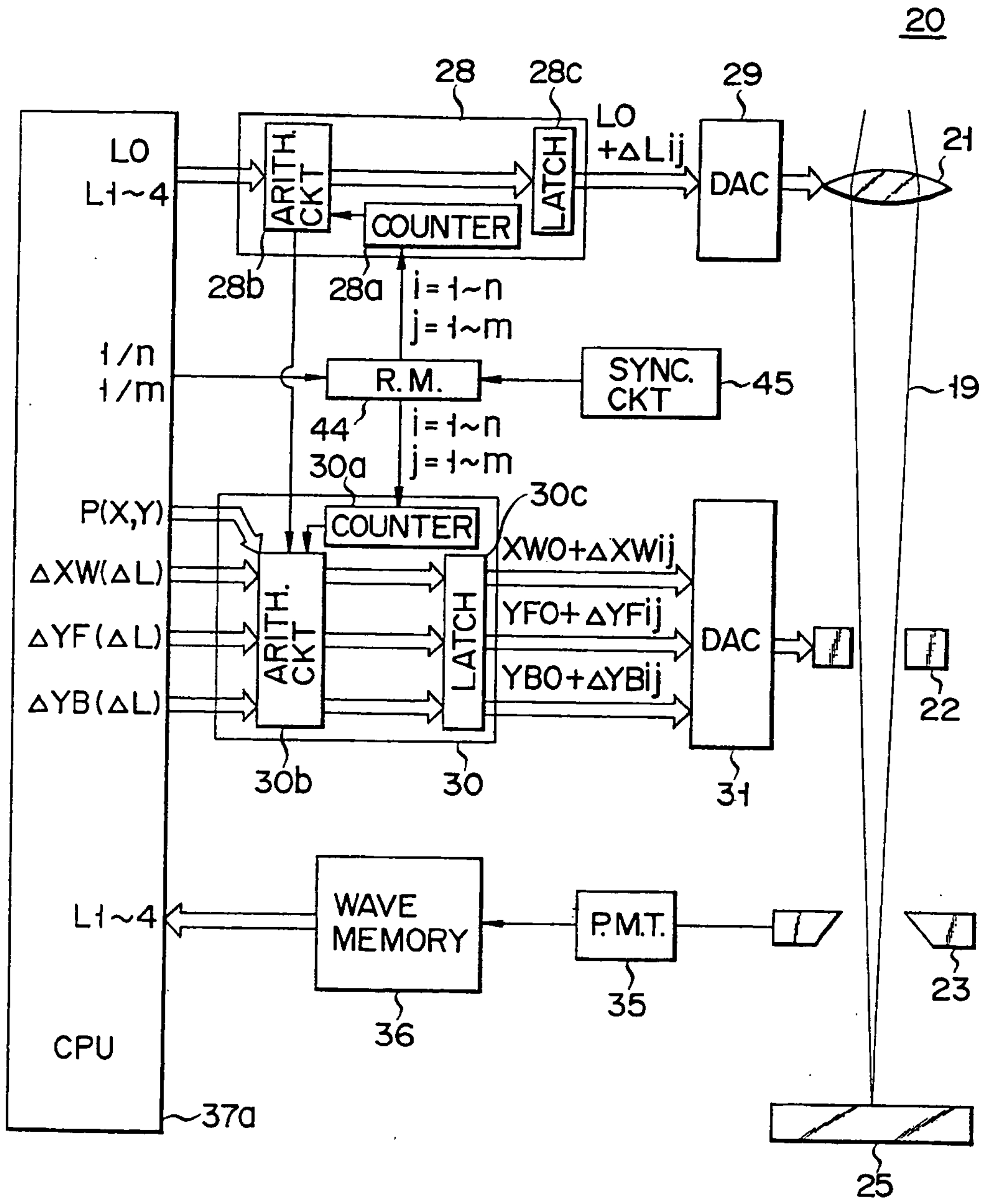

X
Y
A11
25
61
62
1 2 3 4
n
1
2
3
4
m
Anm
64
A1m
63

FIG. 11


20
28
28c
29
LO
+ΔLij
21
LO
L1~4
ARITH. CKT
LATCH
DAC
COUNTER
28b
28a
i=1~n
j=1~m
1/n
1/m
R.M.
SYNC. CKT
45
19
44
i=1~n
j=1~m
30a
30c
P(X,Y)
COUNTER
XW0+ΔXWij
ΔXW(ΔL)
ΔYF(ΔL)
ΔYB(ΔL)
ARITH. CKT
LATCH
YF0+ΔYFij
YB0+ΔYBij
DAC
22
30b
30
31
L1~4
WAVE MEMORY
P.M.T.
23
35
36
CPU
37a
25

SPECIFICATION

## Method of and apparatus for drawing an electron beam pattern

The present invention relates to a method of and an apparatus for drawing an electron beam pattern which are applied to, e.g., an electron beam exposing apparatus.

For example, in order to manufacturing a mask to be used when manufacturing semiconductors using an electron beam exposing apparatus, the electron beam is irradiated onto an electron beam resist formed on a chromium layer which is coated on a glass substrate, thereby drawing a mask pattern. At this time as shown in Fig. 1, a glass substrate 10 held in a cassette 11 is placed on a stage of an electron beam exposing apparatus (not shown) and is set so that the electron beam is just focused on the surface of the glass substrate 10. In case of holding the glass substrate 10 in the cassette 11, it is held in the cassette 11 by a rear cover 13 with a radiating sheet 12 sandwiched between the glass substrate 10 and this rear cover 13. At this time, the adjacent two sides of the glass substrate 10 are pressed by leaf springs 14 against reference surfaces 11X and 11Y in the directions of X and Y (only 11Y is shown) of the cassette 11 and are positioned in the horizontal direction (X—Y direction). On the other hand, the vertical position of the glass substrate 10 is set by pressing the surface of the glass substrate 10 to the points of four positioning pins 16 mounted on the cassette 11 by means of leaf springs 15 on the rear cover 13.

However, if the glass substrate 10 is not set correctly in the cassette 11, the glass substrate 10 will have been placed in the slant state against the stage surface. A decrease in height of the positioning pins 16 due to abrasion also causes the glass substrate 10 to be slant. Thus, the electron beam will not be focused correctly in every position on the surface of the glass substrate 10. The depth of focus of the electron beam which is used in electron beam exposing apparatuses is generally ±10 μm—20 μm; therefore; if an amount of misposition due to inclination of the glass substrate is larger than that value (for example, several tens μm—hundreds μm), the beam current density on the electron beam resist will decrease, so that the pattern width of the mask pattern to be formed will be reduced. For example, in the case where the design-width dimension of the pattern is 10 μm, the width of the pattern to be actually formed becomes thin so as to be 6 μm due to inclination of the glass substrate 10.

Conventionally, the misposition of the glass substrate set or the abrasion of the positioning pins of the cassette cannot be found until the pattern dimensions of the mask manufactured are examined; therefore, a yield in manufacturing masks was extremely bad.

It is an object of the present invention to provide a method of and apparatus for drawing an electron beam pattern which enables an electron beam to be always focused in any position on the surface of a substrate regardless of the misposition of the surface of the substrate to be drawn by the electron beam.

According to the present invention, there is obtained a method of drawing an electron beam pattern comprising the steps of: scanning markers marked two-dimensionally in at least three positions on a substrate to be drawn by an electron beam; obtaining a back scattering electron intensity curve when the electron beam passes on each marker position; obtaining a correction value responsive to the vertical misposition of the substrate to be drawn from the normal in-focus set state on the basis of this reflection electron intensity curve obtained; obtaining distribution correction values of the outputs of an objective lens in the divisional regions to be obtained by imaginarily dividing the substrate when drawing a pattern on the basis of that correction value; and from these distribution correction values, obtaining a correction value of the output of a beam deflecting electrode in each divisional region corresponding to those distribution correction values.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a side elevational view showing an example of a cassette for holding a mask substrate;

Fig. 2 is a functional block diagram when the present invention is applied to an electron beam pattern drawing apparatus of the raster scan type;

Fig. 3 is a perspective view showing the state in that a mask substrate is set in the cassette with inclination;

Fig. 4 is a graph showing changes in the pattern dimensions in each position on the mask substrate when the mask substrate is set with inclination as shown in Fig. 3;

Fig. 5 is a graph showing the state of change of the total pitch due to inclination of the mask substrate;

Fig. 6 is a plan view showing the mask substrate on which markers are marked which is used for the apparatus shown in Fig. 2;

Fig. 7 is an enlarged cross sectional view showing the mask substrate of Fig. 6 which was cut at a marker portion thereof;

Fig. 8 is a graph showing back scattering electron intensity curves of the electron beam from the marker position of Fig. 7;

Fig. 9 is a graph showing the relations between the output correction values of an objective lens corresponding to the out-of-focus of the electron beam and the beam deflection correction values to the mispositions of the horizontal beam;

Fig. 10 is a plan view showing the state in that the mask substrate was imaginarily divided into divisional regions; and

Fig. 11 is a functional block diagram when the present invention is applied to an electron beam pattern drawing apparatus of the vector scan type.

In an embodiment of Fig. 2, an electron beam 19 irradiated from an electron beam source (not shown) of an electron beam projecting apparatus 20 is converged by an objective lens 21 which is an electron lens and passes through a deflecting electrode 22 and then through a scintillator 23 for detecting the back scattering electrons. The electron beam 19 finally focuses on the surface of the electron beam resist formed on a mask substrate 25 held in a cassette 24. This cassette 24 is mounted on a stage 26 and is driven in the X and Y directions in a horizontal plane by a stage driver 27. The focus adjustment of the electron beam 19 by the objective lens 21 is performed by supplying to the objective lens 21 an objective lens control signal produced by applying a digital output from an objective lens controller 28 to a digital-to-analog converter (DAC) 29 of the objective lens system. In addition, the deflection of the electron beam 19 by the deflecting electrode 22 is performed by supplying an output of a deflecting electrode controller 30 to the deflecting electrode 22 through a digital-to-analog converter 31 of the deflection system.

It is now assumed that the mask substrate 25 was set in the cassette 24 in the manner such that one edge portion in the X direction is raised in the vertical direction by only Z as shown in Fig. 3. Thus, the widths of the patterns formed at each point A1—A3, B1—B3, and C1—C3 on the mask substrate 25 are as shown in Fig. 4 due to the out-of-focus of the electron beam 19. Assuming that the pattern width to be obtained in the state in that the mask substrate was normally set is 10 $\mu$m, the pattern widths at points A1, B1 and C1 are kept to the dimensions of about 10 $\mu$m in both X and Y directions. However, the pattern widths at points A3, B3 and C3 were misposition amounts are largest become extremely small to be about 6 $\mu$m in both X and Y directions. In addition, as shown in Fig. 5, an error in proportion to the set misposition amount Z of the mask substrate 25 is also caused in the total pitch of the pattern. In this example, the case is shown whereby the error becomes not lower than 90,001.00 $\mu$m against a true value of 90,000.00 $\mu$m.

In this embodiment, even when the mask substrate 25 was set in the slant state as shown in Fig. 3, its set misposition amount Z is preliminarily detected and the correction responsive to it is performed, thereby enabling errors of pattern width and total pitch to be eliminated. For this purpose, markers are two-dimensionally marked in at least three places on the surface of the mask substrate 25. For example, as shown in Fig. 6, four markers 61, 62, 63, and 64 are formed at the four corners of the mask substrate 25.

As shown in Fig. 7, the mask substrate 25 has a configuration such that a chromium (Cr) layer 72 and a chromium oxide ($Cr_xO_y$) layer 73 are sequentially deposited on a glass substrate 71. For example, in order to form the marker 61 of Fig. 6, the Cr layer 72 and $Cr_xO_y$ layer 73 of the portion where the marker 61 is to be formed are removed by etching to expose the surface of the glass substrate 71 at the bottom portion of the marker 61, then the whole surface of the mask substrate 25 is covered by a resist film 74. The Cr layer 72 and resist film 74 are formed so that their thicknesses are for example 0.1 $\mu$m and 0.5 $\mu$m, respectively.

The mask substrate 25 having the markers 61—64 formed in the manner as described above is held in the cassette 24, and it is fixedly mounted on the stage 26 in such a state. In this embodiment, each of the markers 61—64 is scanned by the electron beam 19 before drawing a beam pattern on the mask substrate 25. For example, in case of scanning the marker 61 by the electron beam 19, the position of the stage 26 is adjusted using the stage driver 27 so that the position of the electron beam 19 in the Y direction locates at Y1 on the mask substrate 25. When the stage 26 is moved in the X direction in this position, the marker 61 is scanned by the electron beam 19.

When the electrons scattered from the portion of the marker 61 by scanning the marker 61 by the electron beam 19 are detected by the scintillator 23, the output curve of that scintillator 23 changes as indicated by a solid line I or a broken line II of Fig. 8. Since the electron scattering coefficient of the $Cr_xO_y$ layer 73 coated around the marker 61 is extremely high, if the incident electron beam 19 just focuses on the surface of this mask substrate 25, the output curve of the scintillator 23 will be as shown by the solid line I. In this case, the dimensions of the spot of the electron beam 19 are equal to or less than the opening dimensions G of the glass surface of the marker 61. A back scattering electron intensity R1 of the solid line I denotes the beam scattering from the glass substrate 71, while R2 represents the beam scattering from the surface of the $Cr_xO_y$ layer 73.

In addition, if the electron beam 19 is out of focus in the portion of the marker 61, the spot dimensions of the electron beam 19 will be larger than the opening dimensions G of the glass surface of the marker 61 and the beam current density will also decrease, so that the back scattering electron intensity at the marker 61 will be as shown by the broken line II. Therefore, it will be appreciated that it is possible to grasp the extent of the out-of-focus from the slope of this broken line II.

The signal representing the reflection electron intensity obtained by scanning the marker 61 by the electron beam 19 in this way is sent from the scintillator 23 to a photomultiplier tube 35 and is amplified, then it is sent to a wave memory 36 and is memorized therein as a digital data. The storage of the data in and the readout from this wave memory 36 are performed by a CPU 38 for processing the reflection electron signal equipped in a control unit 37 indicated by surrounding by a broken line. For the remaining markers 62, 63 and 64, the stage 26 is moved and the data indicative of the reflection electron intensities are stored in predetermined memory locations in the wave memory 36 in the same manner as described above. On the other hand, when the markers 61—64 are scanned by the electron beam 19, charges are stored in the portions of the markers 61—64, so that there is a fear of occurrence of inconvenience when a pattern is drawn later. However, such a problem will not be caused if the number of times of scanning the markers 61—64 is reduced as possible.

If the reflection electron intensity in the position of a certain marker is as shown by the broken line of Fig. 8, it means that the electron beam 19 does not focus in the position of this marker, so that it is necessary to carry out the in-focus operation by adjusting the output of the objective lens 21 in this position. The output correction of this objective lens 21 will be described in detail later.

On one hand, as is obvious from Figs. 4 and 5, in the case where the misposition occurs when the mask substrate 25 is set in the cassette 24, it is also necessary to correct the beam position in the horizontal direction as well as the vertical in-focus adjustment. The horizontal beam position can be corrected by merely adding a correction data to the beam position data which is supplied from a CPU 39 for controlling the deflection system to the deflecting electrode controller 30. It has been confirmed from the actual measurements by the inventors that the correction value of this beam position in the horizontal direction is a function of an objective lens correction value ΔL as shown in Fig. 9 and it has values on the curves such as indicated by ΔXW, ΔYF and ΔYB with respect to the X direction, Y forward direction and Y reverse direction, respectively.

The output of the photomultiplier tube 35, e.g., the data of the curve II of Fig. 8 is stored in the wave memory 36. On the other hand, the data of the curve I of Fig. 8, i.e., the reference reflection electron intensity data in the in-focus state have been preliminarily stored in a disk memory 41 connected to the CPU 38 through a bus 40. Therefore, for example, the objective lens correction values ΔL in various positions in the X direction in the portion of the marker 61 can be calculated by reading out a reference data L0 on the curve I and a measurement value data L1 on the curve II in the respective positions in the X direction from the disk memory 41 and from the wave memory 36 by the CPU 38, respectively, and by obtaining the difference (L0—L1)=ΔL1 between the both by the CPU 38. The data representing the objective lens correction values ΔL calculated in this way is used to access the table in the disk memory 41 to obtain the deflection correction values as shown in Fig. 9. The deflection correction value data on the curves such as indicated by ΔXW, ΔYF and ΔYB have been preliminarily stored respectively in the table in this disk memory 41 in response to various values of the objective lens correction values ΔL.

As described above, by linearly scanning the electron beam 19 on the markers 61—64, it is possible to obtain the objective lens correction values ΔL1—ΔL4 at the markers 61—64 and the deflection correction values ΔXW, ΔYF and ΔYB. The objective lens correction values and deflection correction values over the whole surfaces of the mask substrate 25 are obtained from those values in the manner as described below.

Firstly, as shown in Fig. 10, it is assumed that the region surrounded by the markers 61—64 on the mask substrate 25 is imaginarily divided into n×m rectangular divisional regions Aij (where, i=l—n, j=l—m) to obtain n equal parts in the X-direction and m equal parts in the Y direction. The respective objective lens correction values ΔL1—ΔL4 at the markers 61—64 are then calculated by a CPU 42 for controlling the objective lens system on the basis of the reference data L0 and measurement value data L1—L4. At the same time, the data indicative of values l/n and l/m for equally dividing the mask substrate 25 in the X and Y directions, which data were set in a rate multiplier output value controller 43, are output to a rate multiplier 44. This output timing is controlled by the CPU 42. The clock synchronized with the scanning of the electron beam 19 is supplied from a synchronous circuit 45 to this rate multiplier 44. Therefore, the signals of i/n and i/m corresponding to each divisional region Aij on the mask substrate 25 are output from the rate multiplier 44 so that each one pulse is output for each scan by the electron beam 19. These pulses are supplied to a counter 28a of the objective lens controller 28 and to a counter 30a of the deflecting electrode controller 30 and are counted.

The content of the counter 28a is output to an arithmetic operation circuit 28b in the objective lens controller 28, while in this arithmetic operation circuit 28b, the proportional distribution of the four objective lens correction values ΔL1—ΔL4 supplied from the CPU 42 is calculated using the content of the counter 28a, thereby obtaining the objective lens correction values ΔLij in the divisional regions Aij.

The table memory indicating the relationships of Fig. 9 in the disk memory 41 is accessed by the CPU 42 using the correction values ΔLij obtained as described above, the functions ΔXW (ΔL) ΔYF (ΔL) and ΔYB (ΔL) responsive to the curves of ΔXW, ΔYF and ΔYB are read out, and these function data are transferred to the CPU 39. The CPU 39 supplies these transferred function data ΔXW (ΔL), ΔYF (ΔL) and ΔYB (ΔL) to an arithmetic operation circuit 30b, so that it is possible to obtain the deflection correction values ΔXWij, ΔYFij and ΔYBij in accordance with the count content of the counter 30a.

For example, it is assumed that the mask substrate 25 on the side of the markers 63 and 64 thereof is set in the misposition in the cassette and that the electron beam is in focus on the side of the markers 61 and 62. The correction values at this time are $\Delta L1=0$, $\Delta L2=0$, $\Delta L3=L0-L'$, and $\Delta L4=L0-L'$, respectively.

Firstly, in the divisional regions A1l, . . . A1m of the first column, the objective lens correction values are $\Delta L1l=L0$ and $\Delta L1m=L0-l'$ in the divisional regions A1l and A1m, while

$$\Delta Lij=L0+\frac{j}{m}(L0-L')$$

(where, j=2 to m−1) in the intermediate divisional regions. At this time the deflection correction values $\Delta XW1j$ and $\Delta YF1j$ are the values on the curves $\Delta XW$ and $\Delta YF$ in response to $\Delta L1j$ in Fig. 9, respectively, and these values are obtained by the arithmetic operation circuit 30b.

Next, in the divisional regions A2l—A2m of the second column, the objective lens correction values $\Delta L2=0$ and $\Delta L2m=L0-l'$ in the divisional regions A2l and A2m, while

$$\Delta L2j=L0+\frac{j}{m}(L0-L')$$

(where, j=2 to m−1) in the intermediate divisional regions. At this time, the deflection correction values $\Delta XW2j$ and $\Delta YB2j$ are the values corresponding to the values $\Delta L2j$ on the curves $\Delta XW$ and $\Delta YB$ in Fig. 9, respectively. These values are obtained by the arithmetic operation circuit 30b. The other correction values in the divisional regions A3l—Anm of each column are obtained in the same way as described above.

The objective lens correction values $\Delta Lij$ obtained in this way are sent through a latch 28c to the DAC 29 together with the reference output values, so that the output of the objective lens 21 is corrected in accordance with the divisional regions Aij, thereby enabling the focus adjustment of the electron beam 19 to be performed. At the same time, the deflection correction values $\Delta XWij$ and $\Delta YFij$ or $\Delta YBij$ are sent through the latch 30c to the DAC 31 together with the reference output values XW0, YF0 and YB0, thereby allowing the horizontal position adjustment of the electron beam 19 to be performed.

According to this method, even if the mask substrate 25 is set in the cassette 24 in the slant state, it is possible to always correctly set the depth of focus and horizontal position of the electron beam 19 in any predetermined positions on the mask substrate. Consequently, the pattern dimensions can be correctly obtained as designed.

In the embodiment of Fig. 2, the case has been described whereby the present invention was applied to an electron beam exposing apparatus of the raster scan type, but it can be also applied to an electron beam exposing apparatus of the vector scan type. Fig. 11 shows an embodiment in such a case, wherein the same parts and components as those in Fig. 2 are designated by the same reference numerals. In Fig. 11, the different point from the embodiment of Fig. 2 is that pattern position information P(X,Y) in a chip is supplied to the arithmetic operation circuit 30b of the deflecting electrode controller 30. Although the electron beam is sequentially scanned in the X and Y directions in case of the raster scan type, the pattern position information in the chip is needed to be supplied to the DAC 31 of the deflection system in case of the vector scan type since the pattern positions to be exposed by the electron beam are not sequentially arranged. If the pattern position is known, the objective lens output and deflecting electrode output for positioning the electron beam at a given position can be corrected in that position similarly to Fig. 2. Although the control unit 37 is shown by being divided into the four functional blocks 37, 38, 39 and 43 in Fig. 2, it may be possible to allow one CPU 37a to perform all the control and arithmetic functions as shown in Fig. 11.

In addition, although the markers 61—64 were formed at the four corners on the mask substrate 25 in the embodiment of Fig. 2, it is enough that such markers are two-dimensionally formed at least in the three places other than the pattern forming region on the mask substrate in order to detect the inclination of the mask substrate 25.

As a method of obtaining the objective lens output correction values in the position of each marker, the following methods can be considered other than the method whereby the data of the curve I of Fig. 8 is preliminarily stored in the memory as the reference data and the difference between the data stored in the wave memory 36, e.g., the data of the curve II and the reference data is obtained, thereby calculating such correction values. That is to say, it is now assumed that the data of the curve II was obtained as a result of the electron beam scan of the marker 61 at the first time. This data is stored in the wave memory 36. Next, the output to be supplied from the DAC 29 of the objective lens system to the objective lens 21 is increased while observing the output of the photomultiplier tube 35 on a monitor display (not shown), thereby to adjust such that the output curve of the tube 35 is equal to the curve I in the in-focus state. The difference between the objective lens output adjusted at this time and the objective lens output responsive to the curve II stored in the wave memory 36 is obtained by, e.g. CPU 42, thereby enabling desired objective lens output correction values to be obtained.

## Claims

1. Method of drawing an electron beam pattern comprising the steps of:

scanning markers formed two-dimensionally in at least three places on a substrate to be drawn by an electron beam;

obtaining back scattering electron intensity curves when said electron beam passes through each marker position;

obtaining objective lens output correction values responsive to misposition in the vertical direction from the normal set state of the substrate to be drawn on the basis of said back scattering electron intensity curves thus obtained;

obtaining distribution correction values of the outputs in divisional regions of which said substrate was imaginarily divided when drawing a pattern on the basis of said correction values;

from said distribution correction values, obtaining a correction value of the output of a beam deflecting electrode in each divisional region corresponding to said distribution correction values; and

adding these correction values to the objective lens output and to the deflecting electrode output, thereby irradiating the electron beam.

2. A method according to claim 1, wherein said objective lens output correction values are obtained by adjusting the objective lens output values of electron beam apparatus on the basis of said back scattering electron intensity curves obtained to perform the in-focus operation of the electron beam, and by obtaining the difference between the objective lens output value at the completion of said adjustment and a reference value.

3. A method according to claim 1, wherein said objective lens output correction values are obtained by obtaining the differences between said back scattering electron intensity curves obtained and reference back scattering electron intensity curves and by calculating said objective lens output correction values on the basis of said differences.

4. A method according to claim 1, wherein the pattern drawing in each divisional region is performed by a raster scan method.

5. A method according to claim 1, wherein the pattern drawing in each divisional region is performed by a vector scan method in which data for positioning an electron beam is corrected by said correction value of the beam deflecting electrode output.

6. A method according to claim 1 further comprising the steps of preliminarily preparing a table representing the relation between said distribution correction value of the output in each divisional region and the corresponding output correction value of the beam deflecting electrode, and reading out the output correction values of the beam deflecting electrode from said table using the distribution correction values of the objective lens outputs obtained.

7. An apparatus for drawing an electron beam pattern comprising:

means for obtaining back scattering electron intensity curves when scanning markers formed two-dimensionally in at least three places on a substrate to be drawn by an electron beam;

means for obtaining objective lens output correction values responsive to misposition in the vertical direction from the normal set state of the substrate to be drawn on the basis of said back scattering electron intensity curves thus obtained;

means for obtaining distribution correction values of the outputs in divisional regions of which said substrate is imaginarily divided when drawing a pattern on the basis of said output correction values;

means for obtaining from said distribution correction values a correction value of the beam deflection output in each divisional region corresponding to said distribution correction values; and

means for adding these correction values to the objective lens output and to the deflection output, thereby irradiating the electron beam.

8. A method of drawing an electron beam pattern, substantially as hereinbefore described with reference to the accompanying drawings.

9. An apparatus for drawing an electron beam pattern, substantially as hereinbefore described with reference to the accompanying drawings.

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